Representing Business Models in Primarily Physical Industries: An Ecosystem Perspective

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Abstract. The increasing ubiquity of sensors embedded in products enables innovative business logics in physical industries: value is co-created and exchanged among multiple organizations in a collaborative ecosystem. However, current means of business model design and analysis mainly offer an organizational centric perspective. By adopting a design science approach, we develop a model to represent business models in physical industries from an ecosystem perspective. In this research in progress, focused of the automotive industry, we describe the first cycle of problem identification and artifact design, as well as further steps in our approach.

Keywords: Business Ecosystem · Business Model Representation · Design Science

1 Introduction

In 1965, Gordon Moore suggested that the number of transistors, and thus the power, of an integrated circuit would double every two years, while the cost remained the same [1]. In other words, "the continuing miniaturization of computer and communication hardware […] and more effective power management, has made the vision of ubiquitous computing very close to reality" [2]. This phenomenon, combined with rapidly changing consumer expectations shaped by digital technologies [3], enables the development of new business models (BMs), and organizational forms [4, 5]. Managers perceive the combination of the digital component with their analog product as "extremely challenging" [3]. For instance, car manufacturers are struggling to integrate various forms of computing capabilities into the existing integrated platforms [6]. The viability is also a major hurdle: the design of new BMs with valuable propositions through digital innovation is one of the top managerial concerns in car manufacturing [3]. Automotive is indeed an exemplary industry for research purpose: on-board microprocessors make it possible to design novel services that meet insurance, safety, and maintenance needs [2]. In practice, car connectivity, and therefore access to massive amounts of car data, is broadening the set of players in the car ecosystem, providing new value creation models [7].

This increasing inter-organizational exchange of data and other assets leads to high complexity in business model (BM) analysis and design, where the shift is from organizational to "ecosystemic" focus, or from value creation to value co-creation [8]. In this scenario, an ecosystem perspective in the representation of the business logic is more suited to organizations where both the product and supply and demand chain are digitized [9]. However, while most of BM representations propose an organizational centric perspective [10], only few authors (e.g., Turber et al. 2014) made a first attempt to provide guidelines for designing BMs from an ecosystem perspective. We address this gap by means of a design science approach, building a model for designing and analyzing BMs in physical industries from an ecosystem perspective.

2 Theoretical Background

2.1 Business Ecosystems

"It is no longer enough to think of a firm as a member of a closed system subject to uncontrollable outside shocks. It is actually part of a network that produces its own change" [9]. Building on biological research, [12] theorizes business ecosystems as an economic community that is supported by a foundation of interacting organizations and individuals – the organisms of the business world. Business ecosystems are nested commercial systems where each player contributes a specific component of an overarching solution [13, 14]. This perspective goes beyond suppliers and customers: "Moore expanded previous supply chain network theories to include other organizations such as universities, industry associations and other (non- commercial) stakeholders, as well as the interactions between them" [8]. Through collaboration in a value network, firms exploit their interdependencies and have a competitive advantage over isolated companies, which internalize all components of a value chain [15].

As intrinsic characteristic, business ecosystems do not follow a linear value creation process [14] and many of their players fall outside the traditional value chain [15]. It is not a linear process with upstream and downstream players but a network of companies with many horizontal relations that cooperate to jointly deliver a product or service to a customer, leading to a competition among ecosystems rather than individual organizations [14]. Therefore, the focus needs to shift from linear value creation and capture to value co-creation and co-capture [8].

2.2 Ecosystem Perspective in Business Model Representations

Among the variety of definitions, the BM concept is understood as a "focusing device that mediates between technology development and economic value creation" [16]. With the diffusion of the Internet in the 1990s, The IS community adopted the BM perspective to explain the new ways of value creation and value capture on the Web [17]. Multiple BM representations have been proposed, as combination of components related to either value proposition, creation or capture in the business logic (e.g., [18–20]). These representations are mainly focused on the single organization as core unit of analysis and therefore not suitable for analyzing the interdependent nature of growth and success of companies evolving in an interconnected context [8, 21].

A broader perspective on BMs, where the focus is on multiple organizations, often defined as "actors", is suggested by few authors. These perspectives take different shapes, such as ontologies [22, 23] or frameworks [11, 24] and, although they all refer to "multiple actors that co-create value for the same customer" [25], they are labeled with different terms - e.g., ecosystem or value network. At the best of our knowledge, the framework from [11], looking at BMs for Internet of Things, is the only attempt to provide a generic BM representation for primarily physical industries, taking an ecosystem perspective. However, as stated by the authors, such framework has "some limitations concerning the criteria 'level of detail'" [11]. The component-based ontology from [26] provides instead a fair level of details in representing BMs. However, the authors' focus, being the artifact designed during the diffusion of the Web, is on "real-world services", which has different characteristics from today's ubiquitous computing [2].

3 Proposed Research Approach

The objective of this research is the design of a model to represent BMs in primarily physical industries from an ecosystem perspective. To this purpose, we adopt a design science approach [27], following the method suggested by [28] combined with and adapted according to the four validation gateways proposed by [29]. Overall, our research will provide a contribution to the theory V., design and action [1], since we suggest explicit prescription for designing and analyzing BMs [30]. Table 1 provides an overview of how we apply the method in our research.

Through multiple semi-structured interviews with practitioners, we explore the actual requirements in designing and analyzing BMs from an ecosystem perspective. Secondly, building a taxonomy of the current BM representations (e.g., frameworks or ontologies) [31], we identify the relevant dimensions for our model. The focus on the automotive industry during the design and development phase enables an in-depth analysis of an ecosystem, which is key to reach completeness and effectiveness of the artifact.

Table 1. Design science research approach based on [34] and [35]

Activity	*Method*	*Outcome*
Problem identification and motivation *Status: ongoing*	• Semi-structured interviews with multiple players in the automotive industry	• Collection and analysis of requirements for representing BMs
Definition of solution objectives *Status: ongoing*	• Review of extant research • Taxonomy of dimensions in current BM representations	• Consolidation of dimensions required in the model

	• Selection of relevant dimensions according to the requirements collected through interviews	
Evaluation 1 – Problem formulation, ex ante	• Literature review to justify the research gap • Interviews with consultants in automotive industry to justify the problem statement	
Design and development: *Status: ongoing*	• Iterative prototyping of the artifact in interdisciplinary team, based on specific conceptual modelling language	• Multiple versions of model
Evaluation 2 – Design validation, ex ante	• Interviews with multiple industry players to validate design specifications, artifact clarity, simplicity, completeness and applicability	
Demonstration *Status: planned 2017*	• Multiple pilot workshops with various players from automotive industry and its ecosystem • Cross-industry case study	• Instantiation of the model in artificial setting
Evaluation 3 – artificial setting, ex post	• Instantiation of the artifact in workshops to evaluate its effectiveness, robustness and suitability	
Evaluation 4 – naturalistic setting, ex post	• Validation of artifact' fidelity with the real world phenomenon and its impact in a naturalistic setting, by case studies based on real projects	
Communication *Status: planned 2017/18*	• Academic conferences • Articles in practitioners' outlets • Workshop format	• Peer reviewed publications

4 Preliminary Results

4.1 Problem Identification and Motivation (ongoing)

Two semi-structured interviews with a senior consultant in the automotive industry have been conducted so far. The broad knowledge of the interviewee, with about ten years of experience in consulting the major OEMs and their current or potential partners, allowed us to explore the phenomenon in analysis, reaching a good understanding of the current ecosystems in place and how their actors expect these ecosystems to evolve. The interviewee has also stated a first set of dimensions that need to be considered when designing or analyzing a BM from an ecosystem perspective (table 2).

A minimum of other 10 interviews with other actors are planned. In particular, we expect to collect critical dimensions from two OEMs, two startups, two insurances, two automotive suppliers, one roadside assistance provider one digital car-platform provide, one retailer and one public/government institution (e.g., police department).

Table 2. Dimensions for representing BMs from an ecosystem perspective (January 20th, 2017)

Dimension	*Description*	*Interview 1*	*Interview 2*
Actor's jobs-to-be-done	Needs and motivations for each organization and the end user to be part of the ecosystem	X	
Actor's role	Specific label for each actor according to the value they bring to the ecosystem	X	
Criticality degree of each actor	If and how an actor is essential to the viability of the ecosystem		X
Classification of value exchanged	E.g.: data, IP, money, hardware, etc.	X	
Rights on end user	Direct or indirect interaction of each actor with end user		X
Legal constraints	Legal feasibility of a value exchange (e.g., data security)		X
Bottlenecks analysis	Potentially dangerous value flows		X
Ecosystem opportunities	Overall value (revenues) of the ecosystem	X	

4.2 Definition of Solution Objectives (ongoing)

In this phase we aim at reviewing the literature [32] on representations of BMs to identify existing dimensions that might complement the ones identified in the interviews previously described. Through a key word search on AISeL database, a preliminary collection of relevant representations is currently in place. Out of ten representations collected, including ontologies, frameworks and meta-models, we selected those which have a core focus on ecosystem or network of organizations (e.g., value network as component). This selection led to a current set of five BM representations eligible for our taxonomy of relevant dimensions. To develop such a taxonomy for identifying existing dimensions in BM representations, we are following the method proposed by [31] in the information systems literature. This approach leads to a set of dimensions that complement the ones collected through our interviews. Due to paper-length constraints, in table 3 we propose an extract of the dimensions currently composing our model. We label as "TX" those dimensions gathered from the taxonomy of the existing literature and as "IN" the ones proposed by our interviewees.

Table 3. Partial set of dimensions from taxonomy (TX) or interviews (IN) (February 9th, 2017)

Dimension	*Example*	*Source*
Actor' role	End user	TX, IN
Actor's jobs-to-be-done	Enhanced infoteinment	IN
Devices	Car, smartphone	TX
Value object	Real-time location	TX, IN

Value classification	Data	IN
Value provider	End user (actor), car (device)	TX, IN
Value target (addressee)	Insurance	TX, IN
Value flow classification	Alpha (generic label)	TX
Legal constraints	EU regulations on data security	IN
Bottlenecks analysis	-	IN

4.3 Artifact Design and Development (ongoing)

In figure 1 we show an instantiation of the current version of the model. In this case the simplified ecosystem is composed of six actors (e.g., OEM), which co-create value for a car driver. Each actor has specific value propositions (upper part of the box) and specific jobs-to-be-done (lower part of the box). Each value proposition can be "plugged" to one or more of the jobs-to-be-done of other actors, working as value flow. Out of the two interviews conducted, six types of value flows have been currently identified: data, software, hardware, intellectual property, money, generic. Potential constraints for each value flow, e.g., legal, are represented with a specific symbol. Further dimensions to be included are currently subject to discussion.

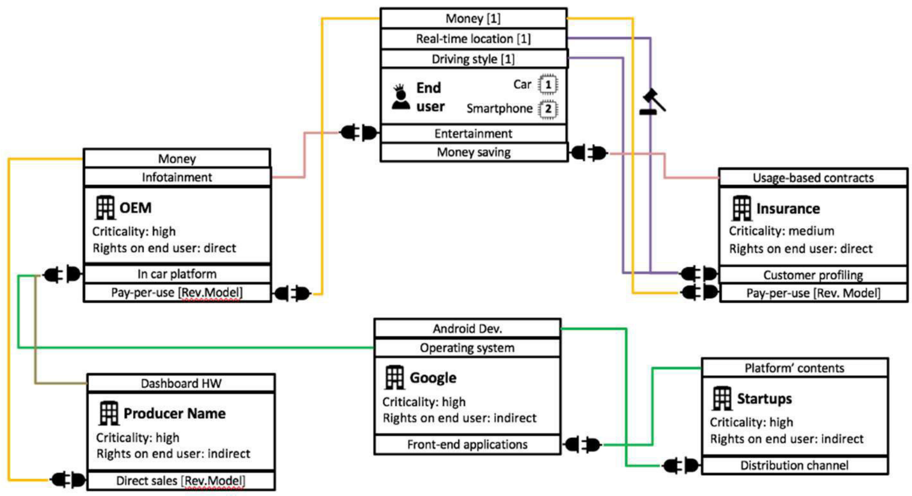

Fig. 1. Instance of the current status of the artifact (February 14th, 2017)

Our current version of the artifact complement the ontology from [33], showing the criticality degree of each actor in the ecosystem, which also enables an evaluation of potentially disruptive bottlenecks. Being privacy and data security critical to todays economy, our model provides also explicit representation of direct or indirect relationships with the end user, as well as potentially disruptive legal constraints. Differently from the framework from [11], our model enables a greater level of details. For instance, our artifact goes beyond the differentiation of monetary and non-monetary benefits, providing six types of value flows and their representation.

5 Further Work

The dimensions collected so far in an exploratory manner are rather generic. By means of in-depth interviews with multiple actors in the automotive ecosystem, we expect to describe specific requirements for representing BMs. This approach is critical to iteratively design and testing the model and improve each composing dimension. Moreover, design principles need to be defined in order to make the model usable by practitioners and scholars.

Although our focus is explicitly on primarily physical industries, we expect to extend our model to industries that leverage connected products to offer services. For instance, we consider public transportation, looking at smart traffic, and therefore potentially relevant for the automotive ecosystem, as relevant case study. The analysis of further industries would increase the generalizability of the artifact which, being focused on the automotive ecosystem, could lack of fundamental elements.

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